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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention relates to the display device provided with a touch panel and this.

[0002]

[Description of the Prior Art]The resistance film system thing which laminated two substrates with which the resistance film was formed in the single-sided surface via the spacer as a conventional touch panel so that each resistance film might counter is known widely, for example, it is used for a display screen, being arranged. These days, since it is used outdoors etc. like car navigation or a notebook computer in many cases, what pasted the polarizing plate together and gave anti-dazzle property to the outside surface side of an upper side board is well used in order to prevent the visibility fall of the display by reflection of outdoor daylight.

[0003]

[Problem(s) to be Solved by the Invention]However, with the polarizing plate, an upper side board curves gradually and the conventional polarizing plate swells, as a result of the coefficient of linear expansion of a polarizing plate producing the difference of expanding quantity between lower substrates when very large compared with a lower substrate since it expands greatly under an elevated temperature (for example, when a lower substrate is glass). As a result, the appearance of a touch panel not only worsens, but since the interval with a lower substrate became large, there was a problem that the operativity of a touch panel got worse.

[0004]For this reason, although a surface film with a small coefficient of linear expansion is stuck on the outside surface side of a polarizing plate and how to control the swelling of the upper side board at the time of an elevated temperature is also considered, Since the conventional polarizing plate had large area contraction after being neglected under the

elevated temperature for a long time, there was a possibility of area contraction having become large, and the polarizing plate having produced the swelling of a touch panel too rather than the resin film of a polarizing plate outside surface, and causing aggravation of operativity.

[0005] Since it is in the tendency to also enlarge a touch panel especially with enlargement of a liquid crystal display panel these days, the problem accompanying the swelling mentioned above is more remarkable.

[0006] This invention is made that such a problem should be solved and aims at offer of the display device provided with still such a touch panel for the purpose of offer of the touch panel which can maintain operativity good irrespective of an environmental change.

[0007]

[Means for Solving the Problem] Open a predetermined interval and said purpose of this invention arranges two substrates with which a resistance film was formed in the surface so that said each resistance film may counter, It is the touch panel which laminated a polarizing plate to the outside surface side of at least one of said substrate, and said polarizing plate is attained by touch panel, wherein area contraction after neglecting it under 80 °C environment for 24 hours is 0.3% or less. Here with "area contraction after neglecting it under 80 °C environment for 24 hours." After cutting off a subject (polarizing plate) in lengthwise direction x transverse direction = 100mm×100mm size and neglecting it under an atmosphere dry 80 °C for 24 hours, it is the value computed with a following formula from longitudinal-direction-length M (mm) returned and measured in ordinary temperature, and transverse direction length T (mm). Area contraction which was carried out in this way and searched for is called following "area contraction after elevated-temperature neglect."

[0008]

[Equation 1]

$$\text{面積収縮率 (\%)} = \{(100 \times 100) - (M \times T)\} \div (100 \times 100) \times 100$$

[0009] In this touch panel, it is more preferred than said substrate with which said polarizing plate is laminated that a coefficient of linear expansion laminates a small surface film to the opposite hand of said substrate to said polarizing plate.

[0010] Said polarizing plate can be made the composition provided with the light polarizer of surface state, and the protective film of this light polarizer stuck on a field on the other hand at least, and, as for said protective film, it is preferred that area contraction after neglecting it under 80 °C environment for 24 hours is 0.3% or less. In the definition of area contraction of the polarizing plate mentioned above, area contraction of a protective film is the value which searched for the subject similarly as a protective film.

[0011] As for this protective film, it is preferred to be stuck on the field of said substrate and an opposite hand at least to said light polarizer, and it is preferred that the phase contrast within

an optical side is 3 nm or less. Here, the phase contrast within an optical side is a value produced by expressing birefringence and multiplying the difference of the refractive index of the direction of X, and the refractive index of the direction of Y by thickness (nm).

[0012]As for said touch panel, it is preferred that a swelling of operation sides after neglecting it under environment of 90%RH at the bottom of environment of 70 ** or 60 ** for 240 hours is 1 mm or less. In a near outermost surface in which a polarizing plate was provided as for operation sides of a touch panel, i.e., inside of two substrates, a swelling of operation sides means here height to a position over an edge part projected most.

[0013]Said purpose of this invention is provided with a touch panel mentioned above and a displaying means which has a display surface, and is attained by display device which has arranged said touch panel in a front face of said display surface.

[0014]

[Embodiment of the Invention]Hereafter, one embodiment of this invention is described, referring to an accompanying drawing. Drawing 1 is a perspective view showing the entire configuration of a touch panel, and drawing 2 shows the state where this touch panel was disassembled.

[0015]As shown in drawing 1, the touch panel 100 is provided with the surface state layered product 110 and the lower substrate 130, the spacer 140 intervenes between the surface state layered product 110 and the lower substrate 130, and the insert part 142 of the connector 120 is further formed in it.

[0016]As shown in drawing 2, as for the surface state layered product 110, the resistance film 111 is formed in the undersurface (lower substrate 130 and field which counters) side. The resistance film 111 consists of ITO(s) (indium tin oxidation thing), for example, and is formed by sputtering processing. It is provided in two side parts of the resistance film 111 so that the electrode 112,112 of a couple may counter. It is connected to the terminal 114,114 provided in the insert part 142 via the circuit pattern 113, respectively, and the upper surface terminal 122 of the connector 120 and the flow of the electrode 112,112 are attained.

[0017]The resistance film 131 which consists of ITO(s) is formed in the upper surface (surface state layered product 110 and field which counters) side like the surface state layered product 110, the electrode 132,132 of a couple counters two side parts of the resistance film 131, and the lower substrate 130 is formed in them. As the lower substrate 130, thin glass about 0.5-2 mm thick is preferred.

[0018]Direction opposing lies at right angles to the direction opposing of the electrode 112,112 in the surface state layered product 110, it is connected to the terminal 134,134 provided in the insert part 142 via the circuit pattern 133, respectively, and the undersurface terminal 123 of the connector 120 and the flow of the electrode 132,132 are attained.

[0019]The spacer 140 is a member of the shape of a frame which consists of a polyethylene

terephthalate (PET) film etc., is stuck on the edge part of the surface state layered product 110 and the lower substrate 130 by the adhesives applied to the surface and rear surface, and holds the predetermined interval (for example, about 100 micrometers). The insert part 142 of the connector 120 is formed by excising some spacers 140. At several places, it is excised by the spacer 140 besides insert part 142, and these function on it as the ventilation part 141 at the time of an internal pressure rise.

[0020]The dot form insulating spacer 160 is arranged at abbreviated homogeneity at the upper surface of the lower substrate 130. This dot form insulating spacer 160 is formed in height lower than the spacer 140.

[0021]Drawing 3 shows the section of the touch panel 100 typically. As shown in the figure, the surface state layered product 110 has the composition that the surface film 101, the polarizing plate 102, the $\lambda/4$ phase difference plate 103, and the upper side board 104 were laminated, sequentially from the upper surface side (surface side), and these are stuck by adhesives, such as acrylic.

[0022]The surface film 101 is a PET film, for example, and it is preferred that thickness shall be about 50-250 micrometers from a viewpoint of intensity or operativity. The $\lambda/4$ phase difference plate 103 is formed, for example considering a polycarbonate (PC) film as a raw material. The upper side board 104 consists of optical isotropy material which has polarizability to no incident light, and can mention the transparent thermoplastic resin of a norbornene system which has aliphatic series cyclic structure, for example.

[0023]Although the surface film 101 in particular is not limited, in order to prevent certainly the swelling of the touch panel at the time of an elevated temperature, it is preferred that a coefficient of linear expansion is smaller than the upper side board 104. For example, to the upper side board 104 which consists of a polyolefin-system-resin film (coefficient-of-linear-expansion $6.2 \times 10^{-5} \text{ cm/cm}^{\circ}\text{C}$), the surface film 101 which consists of PET films (coefficient-of-linear-expansion $1.5 \times 10^{-5} \text{ cm/cm}^{\circ}\text{C}$) can be illustrated.

[0024]Area contraction after the elevated-temperature neglect in which the polarizing plate 102 has composition inserted with the protective films 102b and 102b, and mentioned above both sides of the light polarizer 102a is 0.3% or less.

[0025]The light polarizer 102a and the protective film 102b for obtaining the polarizing plate 102 with small area contraction after such elevated-temperature neglect are as follows.

[0026]The light polarizer 102a is obtained by making it dry under stress, after carrying out orientation of the film which consists of polyvinyl alcohol (PVA) or its derivative by uniaxial stretching, making iodine adsorb and performing boric acid solution processing. Or after immersing the film which consists of PVA or its derivative in the solution of iodine and making iodine adsorb, it is obtained also by carrying out orientation by uniaxial stretching in a boric acid solution, and making it dry under stress. In each above-mentioned process, dichromatic

dye, such as azo, an anthraquinone system, and a tetrazine system, may be used instead of using iodine. From a viewpoint of making it small, area contraction after elevated-temperature neglect. It is preferred to perform sufficient heat treatment in the above-mentioned uniaxial-stretching process, it is preferred to lengthen processing time in the above-mentioned boric acid solution down stream processing, and to raise a bridge construction degree, and it is preferred to use an elevated temperature in the limit where polarizability is not affected in the above-mentioned stress drying process.

[0027]Although the thickness in particular of the light polarizer 102a is not limited, it is usually about 10-40 micrometers. The polarization degree of the light polarizer 102a is not less than 99.7% still more preferably not less than 99.0% more preferably not less than 95.0%. Here, it asks for a polarization degree by the following methods. Namely, pile up two polarizing plates so that a polarization axis may serve as a uniform direction, and the average value T1 of the light transmission which measured continuously the wavelength range of 400-700 nm using the spectrophotometer is calculated, Two polarizing plates are piled up so that a polarization axis may serve as direction crossing at a right angle, T2 is calculated for the average value of the light transmission measured similarly, and a polarization degree is computed with a following formula from these [T1 and T2].

[0028]

[Equation 2]

$$\text{偏光度 (\%)} = \sqrt{\frac{T_1 - T_2}{T_1 + T_2}} \times 100$$

[0029]As the protective film 102b, for example A cyclic olefin system, Resin films, such as a polyester system, a polyolefin system, a cellulose acetate system, a polycarbonate system, a polyvinyl alcohol system, a polyether sulphone system, a polyarylate system, a polyimide system, a polyamidoimide system, and a polyamide system, can be illustrated. In order to employ the performance of the light polarizer 102a in the maximum efficiently, the appearance of the film is excellent also in it, surface smoothness is good and it is preferred that it is a resin film of the small cellulose acetate system of the phase contrast within an optical side or a cyclic olefin system.

[0030]As cellulose acetate system resin, a triacetyl cellulose (TAC) film and a 2 acetic-acid cellulose film are mentioned, for example. A polymer which hydrogenated a ring breakage (**) polymer of cyclic olefin as cyclic olefin system resin if needed, A random copolymer of an addition (**) polymer of cyclic olefin, cyclic olefin, and alpha olefins, such as ethylene and propylene, or a graft denaturation object which denaturalized these (**) polymers with unsaturated carboxylic acid, its derivative, etc. can be illustrated. Cyclic olefin can illustrate norbornene, tetracyclo dodecen, those derivatives (for example, thing which has a carboxyl

group and an ester group), etc.

[0031] From a viewpoint of making small area contraction after elevated-temperature neglect of the polarizing plate 102, thickness of the protective film 102b is not limited in particular, although it is preferred that it is not less than 20 micrometers. As for thickness of the protective film 102b, when handability is also taken into consideration, it is preferred that it is 100 micrometers or less. As for this protective film 102b, it is preferred that phase contrast within an optical side which becomes settled by the definition mentioned above is 30 nm or less as a polarizing function is not checked, it is more preferred that it is 15 nm or less, and it is still more preferred that it is 3 nm or less. In this embodiment, measurement of phase contrast within an optical side was performed using an automatic double reflex meter (product "KOBRA" made from Prince Measuring machine Machine).

[0032] In order for phase contrast within an optical side to obtain the protective film 102b of a value very as small as 3 nm or less, it is necessary to correct distortion of an internal chain of a protective film by a proper method. For example, a method of heating a film in a minus draw before rolling round a film, and a method of neglecting a roll like film rolled round loosely in a heat chamber can be illustrated. When based on the solution casting method, it is preferred to reduce a remains solvent and it is also one method to lengthen a drying furnace. Since it is in a tendency for a photoelastic coefficient to tend to become large, therefore for phase contrast within an optical side to also become large, it is not preferred to add plasticizers, such as dioctyl adipate, dioctyl phthalate, and an isodecyl horse mackerel peat, to a pitch.

[0033] In order for area contraction after elevated-temperature neglect to obtain the polarizing plate 102 which is 0.3% or less, At least one side of the protective films 102b and 102b stuck on a surface and rear surface of the light polarizer 102a, It is preferred that area contraction after elevated-temperature neglect fulfills conditions of 0.3% or less, and it is preferred that the protective film 102b of the light polarizer 102a upper part (surface film 101 side) fulfills these conditions especially.

[0034] In order to obtain the protective film 102b with small area contraction after such elevated-temperature neglect, it is preferred that heat deflection temperature is not less than 90 **, it is more preferred that it is not less than 100 **, and it is still more preferred that it is not less than 120 **. Here, heat deflection temperature is the value measured according to load of 182.2N (18.6kgf) according to ASTM D648.

[0035] If there is too much quantity of a remains volatile constituent, since a volumetric shrinkage will arise by volatile matter content being removed at the time of heating and area contraction will become large, as for a remains volatile constituent, it is preferred that it is 10% or less, it is more preferred that it is 6% or less, and it is still more preferred that it is 4% or less. A remains volatile constituent is the value computed from a rate of a weight change after 160 **x4hr to weight at the time of front [heating] ordinary temperature here.

[0036]In order that the protective film 102b may control increase of area contraction at the time of humidification, it is preferred that water absorption is 3% or less, it is more preferred that it is 1% or less, and it is still more preferred that it is 0.8% or less. With water absorption, it has measured by neglecting it for one week by underwater [23 **] here based on ASTM D570.

[0037]Attachment of the protective film 102b to the light polarizer 102a can be performed using adhesives which can obtain moderate adhesive strength, such as UV cure adhesive, solvent system adhesives, drainage system adhesives, and thermosetting adhesive, and can also be based on other publicly known adhesion (adhesion) means.

[0038]According to the touch panel 100 constituted as mentioned above, since area contraction after elevated-temperature neglect of the polarizing plate 102 is very as low as 0.3% or less, there is no possibility that the polarizing plate 102 may contract rather than the surface film 101, and a swelling of the surface state layered product 110 can be prevented certainly. Therefore, the operativity of the touch panel 100 is maintainable good after elevated-temperature neglect.

[0039]Since the upper side board 104 expands greatly rather than the surface film 101 at the time of an elevated temperature by making small a coefficient of linear expansion of the surface film 101 laminated at the upper surface side of the polarizing plate 102 compared with the upper side board 104, it will be in the state where the surface state layered product 110 was dented. As a result, also in a hot state, the operativity of the touch panel 100 can be made good. Malfunction produced when the surface state layered product 110 and the lower substrate 130 approach can be prevented with the dot form insulating spacer 160.

[0040]This touch panel 100 is formed in the upper surface (display surface) of the solution layer plotting board 200 as a displaying means, as shown in drawing 3. The upper polarizing plate 202 and the lower polarizing plate 203 are arranged in a surface and rear surface of the liquid crystal cell 201, respectively, and this solution layer plotting board 200 is the publicly known composition that the $\lambda/4$ phase difference plate 204 was stuck on the upper surface side (touch-panel 100 side) of the upper polarizing plate 202, further. The $\lambda/4$ phase difference plate 204 may be stuck on the undersurface (lower substrate 130) of the touch panel 100 instead of sticking on the upper polarizing plate 202.

[0041]As mentioned above, although one embodiment of this invention was explained in full detail, as long as area contraction after elevated-temperature neglect is 0.3% or less, various modifications are possible for the polarizing plate 102. For example, a hard court layer, a barrier layer, an easy-bonding layer with the light polarizer 102a, an adhesive layer, etc. may be formed in the protective film 102b of the polarizing plate 102 if needed.

[0042>About the $\lambda/4$ phase difference plate 103 which constitutes the surface state layered product 110, it is also possible to have composition which does not provide this and a certain amount of anti-dazzle property can be obtained even in this case.

[0043] In this embodiment, although the protective film 102b is stuck on up-and-down both sides of the light polarizer 102a, it may have composition which stuck the protective film 102b only on one side of the light polarizer 102a. For example, it is possible to make a function of this protective film use also [phase difference plate / 103 (when not forming the $\lambda/4$ phase difference plate 103, it is the upper side board 104) / $\lambda/4$], without forming the protective film 102b in the undersurface side of the light polarizer 102a.

[0044] When it is not limited to the above-mentioned embodiment, for example, does not form the $\lambda/4$ phase difference plate 103 of the touch panel 100 about the liquid crystal display panel 200, either, it is preferred to have composition which does not form the $\lambda/4$ phase difference plate 204 about the liquid crystal display panel 200, either. Instead of using the liquid crystal display panel 200, it is also possible to use various displaying means, such as a cathode-ray tube (CRT), electro RUMINESSANSU (EL), and plasma (PDP), and the anti-dazzle property of a display surface can be obtained with the touch panel 100.

[0045]

[Example] Working example and a comparative example are given to below, and this invention is explained still in detail.

[0046] (Working example 1) The protective film which consists of a cyclic olefin film (50 micrometers in thickness) was pasted together to both sides of the light polarizer which consists of a PVA film (20 micrometers in thickness) to which iodine was made to stick, respectively, and the polarizing plate was obtained. Area contraction after elevated-temperature neglect of a cyclic olefin film was 0.05%, and area contraction after elevated-temperature neglect of the polarizing plate obtained in this way was 0.10%.

[0047] And as shown in drawing 4, the PET film (75 micrometers in thickness) as the surface film 101 was stuck on the upper surface of this polarizing plate 102 with the acrylic binder, and panel size manufactured a 275x200 mm (12.1 inches) touch panel on it. The ARTON film made from JSR (188 micrometers in thickness) was used for the upper side board 104, and the lower substrate 130 was used as 0.7-mm-thick ITO glass. In drawing 4, the same number is attached about the same thing as the component in drawing 3.

[0048] Next, the elevated-temperature shelf test was done about this touch panel. That is, after neglecting it in each under the environment of 90%RH for 240 hours at the bottom of 70 °C environment, and 60 °C, it returned to ordinary temperature and the swelling of the operation sides (surface film) after 24-hour progress was measured. As a result, there was no swelling under which environment and operativity was good.

[0049] (Working example 2) The protective film by the side of the undersurface of light polarizer (upper side board side) was used as the TAC film currently widely used as a conventional protective film, and also the touch panel was manufactured like working example 1. Area contraction after elevated-temperature neglect of this TAC film is 0.35%.

Although the contraction after elevated-temperature neglect was large, as area contraction of the protective film by the side of the upper surface of light polarizer (surface film side) showed working example 1, since it was very small, as a polarizing plate, area contraction after elevated-temperature neglect was 0.15%, and was a small value.

As a result, in the elevated-temperature shelf test mentioned above, the swelling of operation sides was not seen at all.

[0050](Working example 3) The PET film of the surface film was used as the low shrinkage PET film, and also the touch panel was manufactured like working example 2. Area contraction after elevated-temperature neglect of a polarizing plate is the same 0.15% as the case of working example 2.

The influence by the difference in a surface film did not win popularity.

As a result, there was no swelling of operation sides in the elevated-temperature shelf test mentioned above.

[0051](Working example 4) The binder used for attachment of the surface film to a polarizing plate was used as the binder with stress relaxation nature, and also the touch panel was manufactured like working example 3. Area contraction after elevated-temperature neglect of a polarizing plate is the same 0.15% as the case of working example 3, and the influence by a binder been [influence / it] different and depended did not win popularity. As a result, there was no swelling of operation sides in the elevated-temperature shelf test mentioned above.

[0052](Working example 5) The polarizing plate was constituted, without providing a protective film in the undersurface side (upper side board side) of light polarizer, and also the touch panel was manufactured like working example 4. Area contraction after elevated-temperature neglect of a polarizing plate is 0.20%, and there was no swelling of operation sides too in the elevated-temperature shelf test mentioned above.

[0053](Comparative example 1) Each protective film stuck on both sides of light polarizer was used as the TAC film, and also the touch panel was manufactured like working example 1. Since area contraction after elevated-temperature neglect of this TAC film is 0.35% as mentioned above, area contraction of a polarizing plate after elevated-temperature neglect is 0.35%.

It became a large thing of contraction.

As a result, in the elevated-temperature shelf test mentioned above, also in any of 70 °C environment, and 60 %RH x the 90%RH environment, the center section swelled 2.0 mm to the edge part of a surface film, and operativity got worse.

[0054]

[Effect of the Invention]So that clearly from the above explanation in this invention. A predetermined interval is opened, two substrates with which the resistance film was formed in the single-sided surface are arranged so that each resistance film may counter, and in the

touch panel which laminated the polarizing plate to the outside surface side of at least one substrate, area contraction of the polarizing plate after neglecting it under 80 °C environment for 24 hours is made into 0.3% or less.

Therefore, contraction of the polarizing plate after elevated-temperature neglect is controlled.

Therefore, irrespective of the laminating condition of a polarizing plate, the swelling of operation sides is prevented and the operativity of a touch panel can be maintained good.

[0055]When a coefficient of linear expansion laminates a small surface film to a substrate and an opposite hand to a polarizing plate rather than the substrate with which a polarizing plate is laminated, the swelling of the operation sides at the time of an elevated temperature can be prevented certainly, and operativity can be made good.

[Translation done.]